ECONOMIC REMOTENESS AND WAGE DISPARITIES IN ROMANIA

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Economic Remoteness and Wage Disparities in Romania

Abstract

This paper looks at the link between wage disparities and market access for the Romanian counties. In first place, we derive an econometric specification which relates the income levels of a particular location with a weighted sum of the volume of economic activities of the surrounding locations (market access). Then, empirically, we estimate this econometric specification for a sample of 42 Romanian regions in the year 2006. The paper reports two main results: 1) market access is statistically significant and quantitatively important in explaining cross-county variation in Romanian wages, 2) incentives for human capital accumulation and innovation activities arising from market access size are also affecting the shaping of county wages in Romania. Finally some policy conclusions are also drawn.

Key Words: Economic Remoteness, Market Access, Wage Disparities, Romania
JEL Classification: R11, R12, R13, R14, F12, F23

1. Introduction

The favourable evolution of the Romanian economy in recent years and especially after its take off in 2004 has allowed an important improvement of the development levels among its regions and counties although it was quite uneven. The Romanian accession to the European Union (EU) meant that it has had to reorganize its territory in order to have a more efficient EU fund absorption. From the 42 existing counties, Romania has created 8 economic regions although without legal personality. The counties belonging to the Northeast (1) and Southeast Economic Regions (2) are far removed from the main European markets and experience severe underdevelopment problems. Moreover, their sectoral structure is heavily based on agriculture. On the other hand, the counties belonging to the West (5), Northwest (6) and Center (7) Economic regions benefit from a better location with respect to the main European markets having more potential to attract investors.

Table 1 shows the values of Gross Domestic Product per capita (GDPpc) and gross wages (data in local currency, Romanian New Lei-RON[1]) for the 42 Romanian counties in 2006. The results show quite clearly the dominance of the nation's capital (Bucharest) in terms of both GDPpc and wages. GDPpc in Romania is more than five times higher than the national average and in terms of wages, Bucharest wages are more than 40% higher than the national average. Comparing Bucharest with the poorest county either in terms of GDPpc (Giurgiu) or in terms of wages (Covasna) the data show overwhelming differences (GDPpc in Bucharest is more than 18 times higher than that of Giurgiu and Bucharest wages are more than 75% higher than those in Covasna).

If we exclude from the calculations the distortion generated by the capital values, the results still show that in Romania there is a strong regional contrast in terms of GDPpc and wages. Thus, table 1 shows that the richest city after Bucharest, Timisoara, has a GDPpc which is over three times higher than the national average. Regarding to wages, they are in Ilfov over 30% higher than the national average.

Moreover, these disparities show a well defined "*center-periphery*" gradient in the sense that in the spatial distribution of the Romanian income (excluding Bucharest), the so called "economic center" would be represented by the counties located mainly in the West and Northwest parts of the country whereas the so called "economic periphery"

[1] RON is the official currency of Romania, 1RON=0.297 Euros in 2006

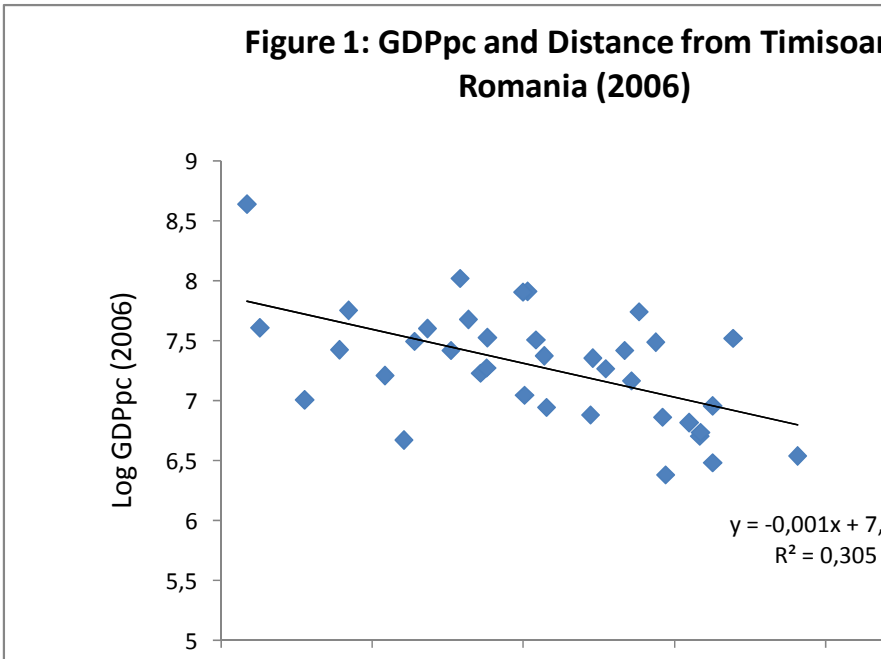
would be represented by the counties located mainly in the Northeast and Southeast parts of the country. Figure 1 plots GDPpc against distance to Timisoara. The results show that as we move further away from Timisoara, the per capita GDP figures (on average) decreases.

Table 1: GDPpc and Gross Wages: Romania (2006)

County	GDPpc	Gross Wages	County	GDPpc	Gross Wages
Bacău	2300	1114	Mehedinti	788	1149
Botoşani	910	942	Olt	1146	1066
Iaşi	3900	1049	Valcea	1382	1013
Neamt	1430	950	Arad	2012	1043
Suceava	1781	946	Caras – Severin	1102	949
Vaslui	814	933	Hunedoara	1672	1065
Brăila	1048	945	Timiş	5651	1136
Buzău	1297	947	Bihor	2328	912
Constanţa	2715	1217	Bistriţa-Năsaud	1820	945
Galaţi	1848	1099	Cluj-Napoca	3050	1197
Tulcea	690	1005	Maramures	1440	910
Vrancea	954	1017	Satu Mare	1670	1003
Arges	2723	1163	Salaj	735	1013
Călăraşi	653	888	Alba	1350	992
Dambovita	1560	1129	Braşov	2718	1076
Giurgiu	589	1009	Covasna	1590	846
Ialomita	840	958	Harghita	1037	917
Prahova	3040	1166	Mureş	2154	1029
Teleorman	974	993	Sibiu	1801	1095
Dolj	1850	1145	Ilfov	1671	1355
Gorj	2000	1286	Bucureşti	10780	1541

	Calculation including the capital (Bucharest)			Calculation whitout the capital (Bucharest)	
Average	1948	1051	Average	1691	1015
Máx.	10780	1541	Máx.	5651	1355
Min	589	846	Min	589	846
Ratio máx./medio	5,53	1,47	Ratio máx./medio	3,34	1,34
Ratio máx./min.	18,30	1,82	Ratio máx./min.	9,59	1,60

Source: Own elaboration based on INSSE figures



Source: Own elaboration based on INSSE figures, data on Bucharest is excluded from the computations

At a theoretical level there are many factors that explain why different regions within a territory do not converge. From the standpoint of economic growth theories (Barro and Sala-i-Martin, 1991, 1995) show that differences in savings rates, investment rates, skilled human capital and difficulties in technology transmission could explain this lack of convergence. Traditional theories of economic development put more emphasis on *first nature geography* factors, i.e. the natural advantages of different locations (access to navigable rivers, ports, airports, allocation of oil, hours of sunshine, etc.) (See Hall and Jones (1999). But since the early nineties, thanks to the seminal work of Krugman (1991) which gave rise to the so called New Economic Geography, a new explanation of the phenomenon of agglomeration of economic activities in space was given by using general equilibrium models grounded in microeconomic decisions where the key ingredients are the existence of increasing returns at the firm level and transportation costs. Krugman (1991) model lead to an explanation of the agglomeration of economic activities based on the so-called *second nature geography* factors. This means that what is really important for seeing agglomeration dynamics is how far a location is from its consumer markets and from its input suppliers. This explanation has reached an important theoretical consolidation and can be considered a more satisfactory way of explaining the agglomeration of economic activities than the explanations based on

arguments of the first nature geography. At empirical level, krugman (1991) model has triggered a plethora of contributions for different geographical scenarios: On the one hand it can be mentioned the contributions looking at income differences for cross country samples or cross regional samples involving different countries (Redding and Venables (2004), Breinlich (2006), Head and Mayer (2006) and Lopez-Rodriguez and Faiña (2006)). On the other hand, there are the contributions looking at cross regional income differences carried out at single country level (Hanson (2005), Roos (2001), De Bruyne (2002), Mion (2004), Pires (2002, 2006), Kiso (2006), Lopez-Rodriguez and Acevedo (2008)).

However, to the best of our knowledge, there are no studies at country level of the forces put at work in Krugman´s (1991) model for any Central and Eastern European country. This paper tries to fill in this gap by applying Krugman´s (1991) model to the regions in a national setting such as the case of Romania. The empirical estimations carried out in this paper show that second nature geography factors play an important role in explaining cross-county wage disparities observed in Romania. Moreover, the results of our estimations are robust to the inclusion of control variables considered important in the explanations of wage disparities across Romanian counties such as human capital and innovation. Our results therefore suggest that those Romanian counties located on the economic periphery of the country suffer from their remoteness in order to catch-up in terms of wages and development levels with the more advance ones. An obvious policy implication in this regard will be the need of implementing policy actions to reduce transport costs directly via improvements in infrastructure (e.g. roads, ports, etc.) which in the case of Romania are still very much lagging behind.

The remaining part of the paper is structured as follows: Section 2 introduces the theoretical framework from which the econometric specifications are derived and are used in the subsequent sections. Section 3 contains the econometric specifications which will be estimated using Romanian data. Section 4 provides information about data sources and the main variables of our analysis. Section 5 presents the results of the estimations and finally, section 6 contains a summary of the main contributions of the paper.

2. Theoretical Framework

Our theoretical framework is a reduced form of a standard New Economic Geography model[2] (multiregional version of Krugman (1991) model) which incorporates the key ingredients to obtain the so called nominal wage equation which will constitute the workhorse of our empirical estimation.

We consider a world with R regions $(j = 1,2,\ldots,R)$, and we focus on the manufacturing sector, composed of firms that produce a great number of varieties of a differentiated good (D) under increasing returns to scale and monopolistic competition. Transportation costs of differentiated goods are in the form of iceberg costs so in order to receive 1 unit of the differentiated good in location j from location i, $T_{i,j} > 1$ units must be shipped, so $T_{i,j} = 1$ means that the trade is costless, while $T_{i,j} - 1$ measures the proportion of output lost in shipping from i to j. The manufacturing sector can produce in different locations

On the demand side, the final consumers´ demand in location j can be obtained by the utility maximization of the following CES function:

$$\max_{m_{i,j}(z)} D_j \qquad (1)$$

Where D_j represents the consumption of the differentiated good in location j. D is an aggregate of the different industrial varieties defined by a CES function à la Dixit and Stiglitz (1977):

$$D_j = \left[\sum_{i=1}^{R} \int_0^{n_i} m_{i,j}(z)^{\sigma-1/\sigma} dz \right]^{\sigma/\sigma-1} \qquad (2)$$

where $m_{i,j}(z)$ represents the consumption of each variety z in location j and which is produced in location i, n_i is the number of varieties produced on location i, σ is the elasticity of substitution between any two varieties where $\sigma > 1$. If varieties are homogenous, σ goes to infinite and if varieties are very different, σ takes a value close to 1.

[2] Other related NEG models can be seen in Fujita et al. (1999)

Consumers maximize their utility (function #1) subject the following budget constraint:

$$\sum_{i=1}^{R} n_i x_{ij}^D p_{ij} = Y_j \qquad (3)$$

Solving the consumer optimization problem, we obtain the final demand in location j of each variety produced in location i.

$$x_{ij}^D = p_{ij}^{-\sigma}\left[\sum\nolimits_{n=1}^{R} n_n p_{nj}^{1-\sigma}\right]^{-1} Y_j \qquad (4)$$

where p_{ij} ($p_{ij} = p_i T_{ij}$), is the price of varieties produce at location i and sold at j and Y_j represents the total income of location j.

Let us define a price index for manufacturing goods as $P_j = \left[\sum\nolimits_{n=1}^{R} n_n p_{nj}^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$

This Industrial Price Index of location j measures the minimum cost of buying 1 unit of the differentiated good D so it can be interpreted as an expenditure function. If we rewrite the expenditure on consumption as $E_j = Y_j$, the final demand at location j can be given by $x_{ij}^{consD} = p_{ij}^{-\sigma} P_j^{\sigma-1} E_j$. However, in order for x_{ij}^{consD} units to arrive to location j, $T_{i,j} x_{ij}^{consD}$ units must be shipped. As a result, the effective demand facing a firm in i from j is given by expression:

$$x_{ij}^D = T_{ij} p_{ij}^{-\sigma} P_j^{\sigma-1} E_j = p_i^{-\sigma} T_{ij}^{1-\sigma} P_j^{\sigma-1} E_j \qquad (5)$$

Turning to the supply side, a representative country i firm maximizes the following profit function:

$$\prod_i = \sum_{j=1}^{R} \frac{p_{ij} x_{ij}^D}{T_{i,j}} - w_i^D (F + c x_i^D) \qquad (6)$$

The technology of the increasing returns to scale sector is given by the usual linear cost function: $l_{Dij} = F + c x_{ij}^D$, where l_{Dij} represents the industrial labour force needed to manufacture 1 unit at location i and sell it at location j, F are the fixed costs units which are needed for manufacturing the industrial good, c is the unit variable cost and

x_{ij}^D is the quantity of each variety demanded at location j and produced at location i ($x_i^D \equiv \sum_j x_{ij}^D$ represents the total output produced by the firm at location i and sold at different j locations) and w_i^D is the nominal wage paid to the manufacturing sector workers at location i. Increasing returns to scale, consumers´ love of variety and the existence of a limited number of potential varieties of the manufacturing good mean that each variety is going to be produced by a single firm at single location. In this way, the number of manufacturing firms coincides with the number of varieties. Each firm maximises is own profit behaving as a monopolist of its own variety of the differentiated good. First order conditions for profit maximisation lead us to the standard result that prices are a mark-up over marginal costs.

$$p_i = \frac{\sigma}{\sigma - 1} w_i^D c \qquad (7)$$

where $\frac{\sigma}{\sigma - 1}$ represents the Marshall-Lerner Price-cost ratio. The higher the ratio, the higher the monopolistic power of the firm. Krugman (1991) interprets σ as an inverse measure of the scale economies due to its interpretation as a direct measure of the price distortion and as an indirect measure of the market distortion due to the monopoly power. Since $\frac{\sigma}{\sigma - 1}$ is higher than 1, Krugman (1991) interprets this result as a proof of increasing returns to scale. Substituting this pricing rule into the profit function, we obtain the following expression for the equilibrium profit function:

$$\prod_i = \left(w_i^D\right)\left[\frac{c x_i^D}{\sigma - 1} - F\right] \qquad (8)$$

Free entry, which assures that long-run profits will be zero, implies that no firm will have incentives to move from one location to another. This implies that equilibrium output is the following one:

$$x_i^D = \bar{x} = \frac{F(\sigma - 1)}{c} \qquad (9)$$

The price needed to sell this many units is given by $P_i^{\sigma} = \frac{1}{\bar{x}} \sum_{j=1}^{R} E_j P_j^{\sigma-1} T_{i,j}^{1-\sigma}$. Combining this expression with the fact that prices are a constant mark-up over marginal costs in equilibrium, we obtain the following zero-profit condition:

$$w_i^D = \left(\frac{\sigma - 1}{\sigma c} \right) \left[\frac{1}{\bar{x}} \sum_{j=1}^{R} E_j P_j^{\sigma-1} T_{i,j}^{1-\sigma} \right]^{1/\sigma} \qquad (10)$$

This equation is called nominal wage equation which constitutes the key relationship to be tested in the empirical part of this work. According to equation (10), the nominal wage level in each location i depends on a weighted sum of the purchasing capacities of the different j locations where the weighted scheme is a decreasing function of the distance between locations. In the New Economic Geography literature, the expression on the right hand side of equation (10) has been labelled with different names market access (Redding and Venables, 2004) and real market potential (see Head and Mayer, 2004)[3]

We will refer to this expression as market access and will be labelled as MA. The meaning of this equation is that access advantages raise local factor prices. More precisely, production sites with good access to major markets because of its relatively low trade costs tend to reward their production factors with higher wages.

If we normalize the way we measure production, choosing the units such as that $c = \frac{(\sigma - 1)}{\sigma}$, $F = \frac{1}{\sigma}$, and defining the market access of location i as $MA_i = \sum_{j=1}^{R} E_j G_j^{\sigma-1} T_{i,j}^{1-\sigma}$, we can rewrite the nominal wage equation as:

$$w_i^D = \left[MA_i \right]^{1/\sigma} \qquad (11)$$

[3] This expression is semantically analogous to the one employed by Harris (1954) but the term real refers to the fact that price difference between different locations are taken into account. The concept of nominal *market potential* of Head and Mayer (2004) is a concept similar to the Harris (1954) market potential

This simplification of the nominal wage equation is very similar to the Harris (1954) market potential function in the sense that economic activity is more important in those regions which are close to large markets.

3. Econometric Specification

Taking logarithms in expression (11), the estimated nominal wage equation is based on the estimation of the following expression:

$$\log(w_i) = \theta + \sigma^{-1} \log[MA_i] + \eta_i \qquad (12)$$

Where η_i is the error term and the other variables are as defined in the previous sections. This equation relates the nominal wage in county i with income in other counties, weighted by distance and price. Therefore, in accordance with the predictions of the theory, the higher the levels of income and price levels and the lower the distance between locations, the higher will be the level of local wages. This specification captures the notion of a spatial wage structure and allows us to verify the direct relationship between the nominal wage of a location and its market access which is an important condition to observe agglomeration dynamics.

However equation (12) is a restricted specification to analyze the potential effects market access has on wages as we cannot say whether the regression captures causality or simply captures correlations with omitted variables such as human capital, innovation and so on. To address these potential impacts and control for the possibility of other shocks that are affecting the dependent variable and are correlated with market access, we also estimate an alternative specification that explicitly takes into account the above considerations. Therefore we expand our baseline estimation (eq. 12) to allow for the inclusion of control variables which may be affecting cross-county wage levels by estimating the following equation:

$$Lnw_i = \theta + \sigma^{-1} \ln MA_i + \sum_{n=1}^{N} \gamma_n X_{i,n} + \eta_i \qquad (13)$$

Where X_{in} is a vector of control variables and γ_{in} the corresponding coefficient.

4. Data Source and Construction of variables

The data for this paper refers to the year 2006 and was taken from different sources, National Statistical Institute of Romania (INSEE), the statistical office of the European Union (EUROSTAT) and data from various ministries of the Romanian Government.

First, the dependent variable of the model was approximated by using 2006 data on gross wages at county level. These data come from the Romanian National Statistical Institute. The advantages of using wages as a proxy for the dependent variable instead of figures on per capita GDP is based on the fact that we do not incur the typical overestimation issue that arises when people have to commute to their work places or there are foreign factors in the production. Although Gross Domestic Product better captures the added value generated by the factors of production in a county or regions, the data on wages better captures what is left to remunerate domestic factors of production in that country or region by also taking into account the amount of fiscal transfers to the different counties.

Second, with respect to the independent variables, our main variable of interest is market access. This variable was built using 2006 data as a distance-weighted sum of the volume of economic activity in the surrounding regions. We proxy each county´s volume of economic activity by its total gross domestic product. With respect to the calculation of the discount factor it is based on the distances measured in Km between the capital cities of the 42 counties in which Romania is divided. Data on distances between capital cities was obtained from the website www.travelworld.ro. The calculation of the internal distance within each county is approximated by a function that is proportional to the square root of each county´s area. The expression used for calculation is $0.66\sqrt{\frac{Area}{\pi}}$ where "Area" represents the size of the county expressed in km2. This expression gives the average distance between two points on a circular location (see Head and Mayer, 2000, Nitsch 2000, Crozet 2004 for a discussion of this measure of internal distance).

The other independent variables refer to innovation and human capital which in the model act as control variables. The reason for using these controls is based on the fact that they might be affecting our dependent variable through our market access measure. Innovation at county level is proxy by the county share on R&D expenditure (measured as the percentage of the county Gross Domestic Product). With respect to the human

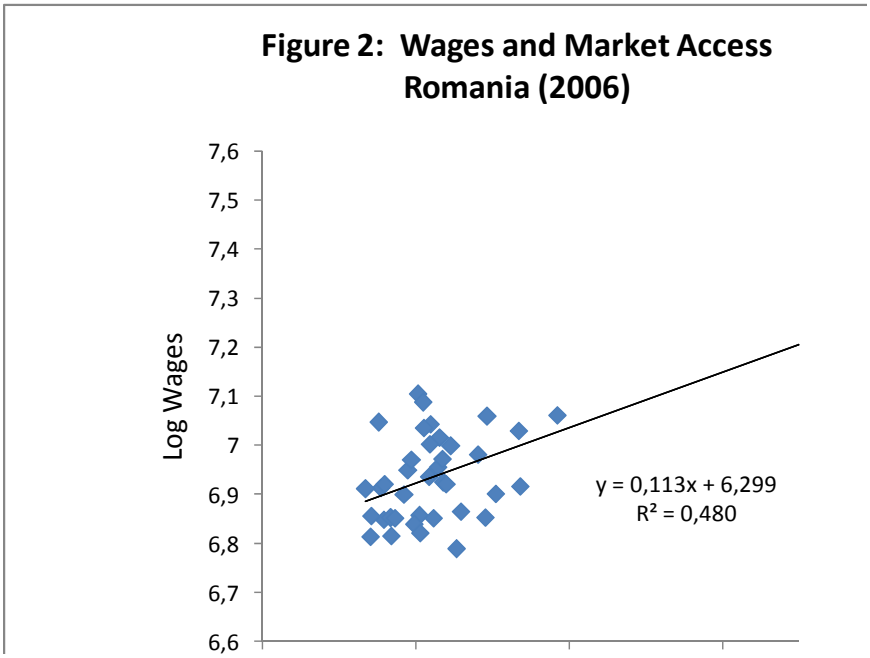
capital variable we consider the percentage of each Romanian county´s population that has attained secondary and tertiary education. Data for all the control refers also to the year 2006 and was obtained from the Romanian National Statistical Institute (INSEE).

5. Empirical Results

5.1 Market Access and Wages: Preliminary Analysis

In this section we present and discuss a series of graphs which give a first visual approach to the empirical estimates carried out in the next section. Figure 2 plots log regional wages on log market access. This preliminary approach shows a positive effect of market access shaping regional wages which is in line with the theoretical propositions derived from the model proposed in section 2 of the paper.

Figure 2: Wages and Market Access Romania (2006)



Source: Own elaboration based on INSSE figures

In the composition of the Romanian market access, it is actually instructive to further split it up into two components, the domestic component and the foreign component. The domestic market access (DMA) of a Romanian county refers to the contribution made to total market access (TMA) by the county itself and the foreign market access (FMA) of a Romanian county is the contribution made to total market access (TMA) by

the surrounding Romanian counties. Therefore, the analysis of these two components of the TMA allows us to clarify the relative importance of each market access component and therefore we can estimate which has more impact in shaping wages at county level. Table 2 provides some information on the average composition of market access for the 42 Romanian counties by breaking down total market access (TMA) into its two components, the domestic component (DMA) and the foreign component (FMA).

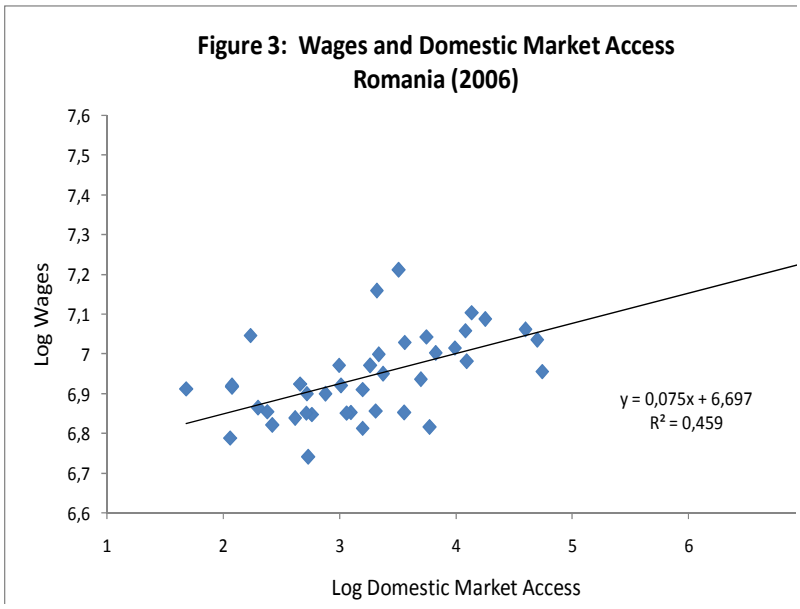
Table 2: Summary Statistics on Market Access: Romania (2006)

County	DMA	TMA	DMP / TMA	County	DMP	FMP	DMP / TMA
Bacău	54	233	19%	Mehedinti	9	183	5%
Botoşani	16	183	8%	Olt	20	272	7%
Iaşi	115	169	41%	Vâlcea	20	279	7%
Neamț	27	224	11%	Arad	29	204	13%
Suceava	35	173	17%	Caras-Severin	11	173	6%
Vaslui	14	229	6%	Hunedoara	26	212	11%
Brăila	15	260	5%	Timiş	110	149	43%
Buzău	22	364	6%	Bihor	44	166	21%
Constanța	63	186	25%	Bistrița-Năsaud	21	193	10%
Galați	46	222	17%	Cluj-Napoca	70	187	27%
Tulcea	5	190	3%	Maramures	25	158	13%
Vrancea	14	278	5%	Satu Mare	25	152	14%
Arges	59	331	15%	Salaj	8	192	4%
Călărași	8	312	2%	Alba	18	209	8%
Dambovita	35	444	7%	Braşov	60	308	16%
Giurgiu	8	476	2%	Covasna	15	307	5%
Ialomita	10	319	3%	Harghita	11	241	4%
Prahova	99	516	16%	Mureş	40	227	15%
Teleorman	15	397	4%	Sibiu	28	280	9%
Dolj	42	227	16%	Ilfov	33	5633	1%
Gorj	28	203	12%	Bucureşti	3631	552	87%

TMA	Total Market Access
DMA	Domestic Market Access
TMA	Foreign Market Access

Source: own elaboration

It can be seen that overall the foreign component of market access dominates the domestic component. However, excluding Bucharest, it is worth remarking the relative importance of the domestic component in the Romanian most dynamic counties with percentages over total market access above 20% such as the cases of Iasi, Constanta, Timis, Cluj-Napoca, Bihor and Bacau. Within this set of regions Iaşi county, located in the so-called Region 1-Northeast, and Timisoara county, Region 5-West, stand over the others with a domestic contribution to total market access above 40%. The reason behind these high values of the domestic component lies in the fact that these counties are important growth poles within the country with an important weight in both population and GDP. Timiş county, geographically situated in the west on the border with Serbia and Hungary, has a better access than other Romanian counties to the main central European markets. In fact within a 500 km radius there are four European capitals. Moreover, the county belongs to the euro-region DKMT (Danube, Cris, Mures-Tisa) jointly with other counties from Serbia and Hungary. The other case is Iasi, Romanian's most populous county with nearly 800,000 inhabitants, the ancient capital of the country (before unification) and the largest cultural center of eastern Romania. It works as a growth pole in the Region 1- Northeast. Cluj-Napoca is also an important pole of economic growth in Region 6-North West with a history marked by multiculturalism, along with the Region 7-Center, and the domination of the Austro-Hungarian Empire. These facts have made possible that Hungarian, German and Austrian investments in these regions are higher than the national average. Representative sectors in these counties are the pharmaceutical, the chemical and the high tech ones.



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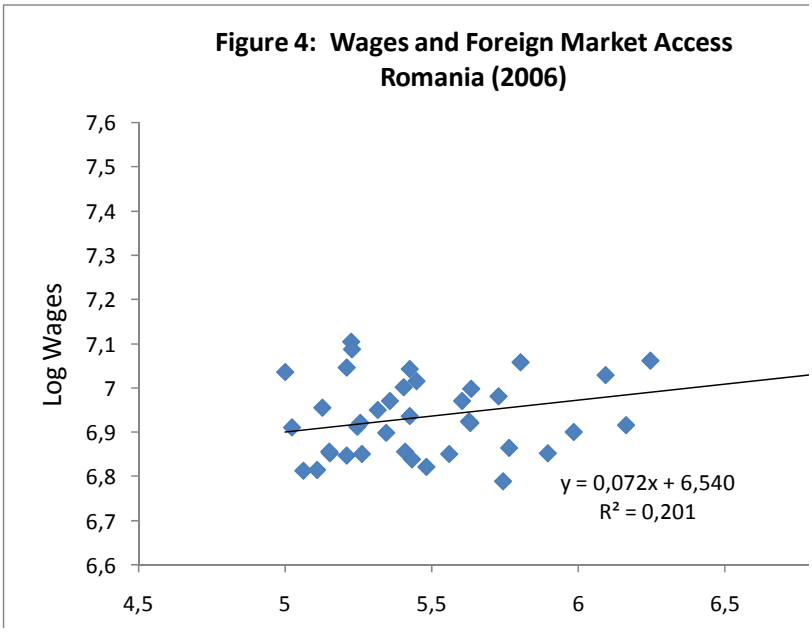
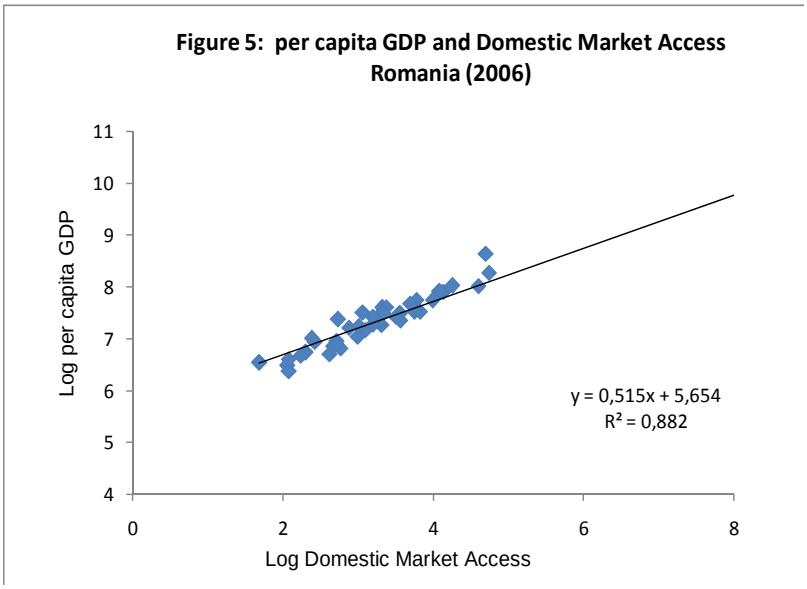


Source: Own elaboration based on INSSE figures

Figures 3 and 4 give a first approximation to the importance the domestic and foreign components of market access represent in relation to the wages of each county. As it is shown in figure 4 the two components have a positive effect on wage levels observed in

each county but the important weight the domestic component of market access has in explaining wages is clearly seen by the better fit of the regression.

If instead of using wages as the dependent variable we use per capita GDP, the relationship between per capita GDP and domestic market access is much more relevant. This is clearly seen in figure 5 where the set of points adjust better to the trend line with an explanatory power close to 89%.



Source: Own elaboration based on INSSE figures

The above figures show a positive relationship between income levels, either approximated by wages or per capita GDP figures, and market access for the Romanian regions. The rationale behind these effects of market access on income levels is based on the direct trade cost savings that accrue to central locations.

5.2 Market Access and Wages: Econometric Estimations

Table 3 presents the results of different estimations of equation 12 for the 42 Romanian counties in the year 2006. In column 1 we regress wages on total market access (foreign plus domestic) using OLS.

Table 3: Market Access and Romanian Income: Baseline Estimations (Romanian Regions, 2006)

Dependent Variable	Log Wages 2006					
Regressors	(1)	(2)	(3)	(4)	(5)	(6)
Constant	6.29**	6.26**	6.69**	6.54**	6.38**	6.28**
	(0.11)	(0.13)	(0.04)	(0.13)	(0.23)	(0.13)
Log MA2006	0.11**	0.12**				
	(0.02)	(0.02)				
Log DMA2006			0.07**			
			(0.01)			
Log FMA2006				0.07**		
				(0.02)		
Log MA2006					0.09**	0.12**
					(0.04)	(0.02)
Estimation	OLS	IV	OLS	OLS	IV	IV
Inst. variables						
First stage R2		0.66			0.22	0.73
R2	0.48	0.47	0.40	0.20	0.47	0.48
Prob (F-statistic)	0.00	0.00	0.00	0.00	0.00	0.00
Number observations	42	42	42	42	42	42

Note: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis;** denotes statistical significance at 5% level ,* denotes statistical significance at 10% level;"First stage" R2 is the R2 from regressing market access on the instruments set, Instruments: Distance to Timisoara and region Size Columns (2), Average Distance (5) and Average Distance and region Size (6)

The estimated coefficient on market access is positive and statistically significant at 5% level and the R2 of the regression is 0.48. This first result is in line with the theoretical expectations, showing that doubling a county market access would increase its wages by 11%. As a robustness test, column (3) enters log domestic market access and column (5) enters log foreign market access as separate terms in the regression equation. Theory tells us that this regression is misspecified, and we see that the R2 is lower than with the correct specification (column (1)). However, both terms are positively signed and statistically significant at the 5% level.

However, the use of market access as the only regressor brings the problem of reverse causality in the sense that in its computation we include the Gross Domestic Product of each Romanian county which in turn is increasing in wages as captured by the dependent variable, log wages. This endogeneity problem can cause inconsistent and biased estimates. In order to address this issue, we use instrumental variables to estimate the effect of market access on wage levels.

Determining a causal effect of market access on wage levels depends on the availability of instruments. These need to be variables that are determinants of market access but exogenous with respect to wage levels. Furthermore, they should also be variables that are not driven by an unobservable third variable the authors suspect might be jointly affecting market access and wages. Taking into account these premises and following other studies carried out on spatial economic issues quite linked to the nature of this research (Breinlich (2006) and Lopez-Rodriguez *et al.* (2007)) in this paper we use as instruments geographical variables which are the most suitable candidates for such estimation and are exogenous determinants of market access. Therefore, we instrument market access with a different set of instruments: In column 2 we instrument market access with distance from Timisoara and with the county's size. The first instrument captures the market access advantages of locations close to the geographic centre of Romania (Excluding Bucharest) while the second instrument captures the advantage of large regional markets in the composition of domestic market Access. In column 5 we only use as instrument the average distance each county has to the surrounding ones and in column 6 we instrument market access with average distance and with county´s size.

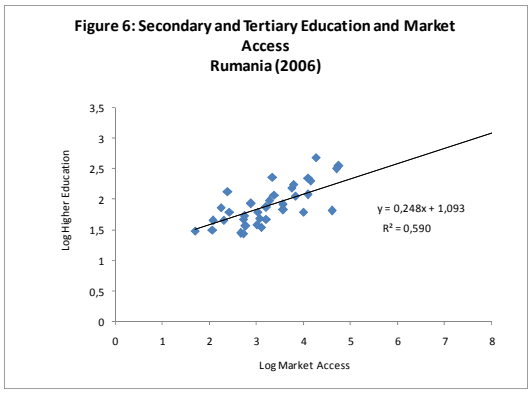
In columns, 2, 5 and 6 the effect of total market access on wage levels is estimated using different sets of instruments. The instruments are highly statistically significant and have the expected signs. The p-value for an F-test of the null hypothesis that the coefficients on the excluded instruments are equal to zero is 0.00. Distance to Timisoara and county's size explains about 66% of total market access. When using average distance as instrument, only 22% of the spatial variation in market access is explain by this instrument and finally when instrumenting market access with average distance and county´s size about 73% of total market access is explain by these two instruments. Since the instruments represent quite distinct source of information and are uncorrelated, we can trust them to be reliable instruments. However, we examine the validity of the instruments using a Hansen J test of the model overidentifying

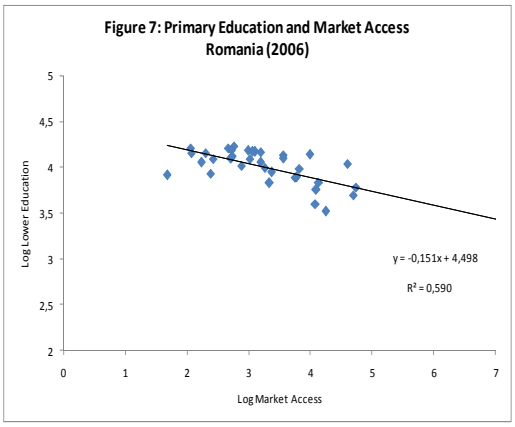
restrictions. For our market access measure we are unable to reject the validity of the instruments. In the second-stage wage equation, we again find positive and highly statistically significant effects of market access on Romanian wages, with the IV estimate of the market access coefficients close to those estimated using OLS. The intuitive interpretation of the results presented in Table 3 suggests that high market access counties have a better access to consumer markets. Therefore as manufacturing firms have to sell their output in different locations incurring in transportation cost, the added value that remains to pay local factors of production, among them labour, is higher in central locations (high market access) than in remote ones.

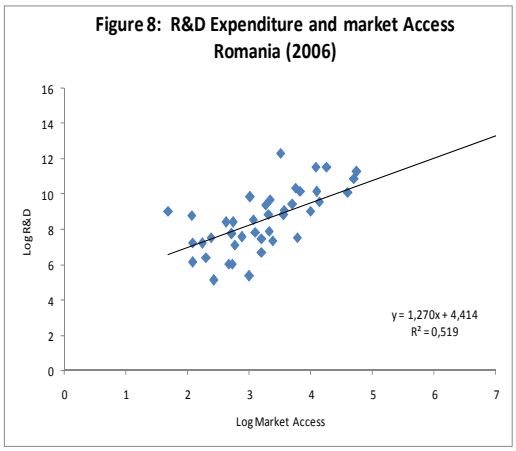
Robustness Checks

The above analysis shows a positive relationship between wage levels and market access. However these positive relationships may be due to third variables that are affecting regional wage levels through the market access and which might be working through accumulation incentives such as human capital, innovations and so on. In fact, high market access also provides more long-run incentives for human capital accumulation by increasing the premium for skilled labour. As Redding and Schott (2004) argue, this will be the case if intermediate and trade cost intensive goods are also relatively intensive in that production factor. Since it seems reasonable a priori that similar conditions hold for capital intensive goods, centrality might also have a positive impact on physical capital accumulation. Indeed, stocks of human capital are highly correlated with market access in the Romanian regions under study here, at least for the period for which data are available (2006). Innovative activity is also affected by spatial proximity and geography. The interaction of high market access in dense and central Romanian regions which makes them large and profitable markets for innovation, together with increasing returns to innovation and localization of the knowledge spillovers, seem to explain the pattern of high concentration of innovative activities in the so called "economic center" of Romania such as the capital, Bucharest, with a significant weight in sectors such as the pharmaceutical (over 90%)and other regions, Iasi and Cluj Napoca which have the monopoly of production of certain drugs. Other growth poles where innovative activities are important are the cities of Timisoara, Constanta, Galati, Craiova and Ploiesti that have focused on the chemical industry.

The next panel contain 3 figures (figure 6 to figure 8). The first two figures of the panel plot the percentage of individuals with secondary and tertiary education in each Romanian county (log Higher Education, Figure 6) and the percentage of individuals with primary educational attainment levels (log Lower Education, Figure 7) against market access, where the second panel (Figure 8) does the same for for the expenditure on R&D activities. As is already apparent in the figures, market access shows a positive correlation with high and intermediate levels of education and the expenditure on R&D activities and a negative correlation with primary education. Although naturally there are a large number of alternative determinants of human capital accumulation and the size of R&D activities, this finding is at least supportive of a potential long-run impact of market access.







Source: Own elaboration based on INSSE figures

As is already apparent in the figures and confirmed in the regression results reported in Table 4, market access shows a significantly positive correlation high and intermediate levels of education and with R&D expenditures.

While a more detailed investigation of the role of market access in affecting human capital formation and the size of R&D activities is beyond the scope of this paper, we will try to answer a related question. Therefore, assuming that a significant portion of the advantages of centrality operates through accumulation incentives, what is the importance of the direct trade cost advantage central to the theoretical part of this paper? A straightforward way of testing this is by including human capital and the size of R&D activities as additional repressors in the baseline specification estimated earlier.

Table 4 : Market Access, Human Capital and R&D Expenditure
(Romanian regions, 2006)

Dep. Variable:	Log (Higher Education)	Log (Lower Education)	Log (R&D Expenditure)
Regressors			
Constant	1.09**	4,49**	4.41**
	(0,16)	(0.07)	(0,6)
Log MA2006	0,25**	-0,15**	1.27**
	(0.03)	(0.02)	(0,19)
Estimation	OLS	OLS	OLS
R2	0,59	0,59	0,52
N. observations	42	42	42

Notes: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis; MA2006 refers to the market access index for the year 2006 computed using gross domestic product as a proxy for the volume of economic activity

** indicates coefficient significant at 5% level * significant 10% level

The next table, table 5, presents our preferred specification of the relationship between market access and wages where we use as control variables the ones mentioned above which could be affecting wages through the market access (equation 13). Therefore we control for cross-county variation in the levels of human capital and for the size of R&D expenditures. The first control variable, human capital, is measured (in logs) as the 2006 percentage of individuals with secondary and tertiary education in each Romanian region (labelled as log Higher Education). The second control variable, size of R&D

expenditure gathers 2006 regional expenditures on R&D activities (also measured in logs).

Table 5: Market Access and Regional Income: Extended Estimations (Romanian Regions, 2006)

Dependent Variable	Log Wages 2006			
Regressors	(1)	(2)	(3)	(4)
Constant	6.10**	6.10**	6.10**	6.13**
	(0.10)	(0.19)	(0.19)	(0.11)
Log	0.11**	0.11**	0.09**	0.09**
MA2006	(0.02)	(0.03)	(0.02)	(0.02)
Log	0.11**	0.11**	0.07**	0.07**
Higher Education 2006	(0.02)	(0.02)	(0.03)	(0.03)
Log			0.02**	0.01**
R&D Expenditure 2006			(0.001)	(0.001)
Estimation	OLS	IV	OLS	IV
Inst. Variables First stage R2		0.73		0.73
R2	0.65	0.66	0.69	0.69
Prob (F-statistic)	0.00	0.00	0.00	0.00
Number observations	42	42	42	42

Note: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis, ;** denotes statistical significance at 5% level ,* denotes statistical significance at 10% level;"First stage" R2 is the R2 from regressing market access on the instruments set, Instruments: Average Distance to other regions and region Size

Columns 1 to 4 contain a summary of the estimation of equation 13. In Colum 1 we regress (OLS estimation) county wages on the total market access and controlling for human capital. The results of the estimation show that the coefficients are in line with the expectations and the coefficient of our main variable of interest, market access, is positive and statistically significant. Moreover its value is the same as in the baseline estimation, column 1 Table 3. On the contrary, the explanatory power of the regression has increased seventeen percentage points from the baseline estimations (0.48% to 0.65%). In column 3 we add as an additional control variable to the estimation in column 1 the size of R&D expenditures (OLS estimation). Even in this case, with the inclusion of both controls, the estimation still reports a positive and statistically significant market access coefficient. However, the value of the market access

coefficient declines around 25% moving from 0.12 (column 6, Table 3) to 0.07. Still in this case if we double the market access, county wages would increase by 7% after controlling for human capital and for the size of R&D expenditures. The explanatory power of the regression increases around 43%, (from 0.48% to 0.69%).

In order to address the potential reverse causality problem of market access, as we did in the earlier estimations (Table 3), we instrument total market access with each county average distance to other counties and with county size. Columns 2 and 4 of table 4 report the results using IV estimates. As we can see from the estimations, the results back the ones obtained in the OLS estimations with no changes in the coefficient estimates.

Although these results show some variability in the estimated coefficient on market access (with respect to the baseline estimations), it always retains both economic and statistical significance. This provides evidence that the estimated market access effects are not being driven by unmodelled (third) variables correlated with both market access and county wages. In the light of these results, it seems likely that access to sources of demand is indeed an important factor in shaping the regional wage structure in Romania.

6. Conclusions

In this paper we have built a New Economic Geography model an estimate an econometric specification which relates the levels of wages paid in each location with an index of the degree of accessibility to consumer markets in that location. The estimations have being performed for a sample of 42 Romanian counties for the year 2006. The paper reports two main results: From our baseline estimations we clearly show that market access play a key role in shaping the county wage structure observed in Romania. Turning to our preferred specification, our results also show that two important channels through which market access might be affecting wage levels in Romania are human capital levels and R&D expenditures.

Our results emphasize the role of remoteness in avoiding Romanian wage differences to be bid away and so in acting as a penalty for the economic catching up of the poorest Romanian counties towards the more developed ones. In addition, peripherality may hamper human capital accumulation and also innovation. Taking into account that human capital accumulation and innovation are two key ingredients for regional

development and to accelerate the development levels of the regions lagging behind, one obvious policy implication is that Romanian economic remote counties should make bigger efforts to improve both human capital and innovation in order to partially offset the penalties impose by remoteness. We think that an important role in this sense should be played by the European Union Regional Policy

This research is open for further research. Perhaps the most important things to analyze in future extensions of this paper is to consider other hypotheses that can compete in explaining the spatial wage structure observed in Romania, or seek alternative channels that may be affecting wages in addition to human capital and innovation.

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